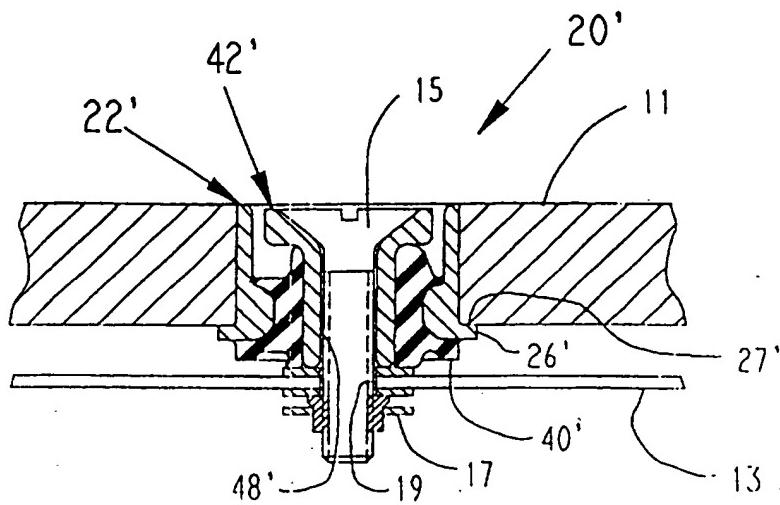




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :	A1	(11) International Publication Number: WO 98/12453
F16F 1/38		(43) International Publication Date: 26 March 1998 (26.03.98)
(21) International Application Number:	PCT/US97/15548	(81) Designated States: BR, CA, CN, JP, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).
(22) International Filing Date:	4 September 1997 (04.09.97)	
(30) Priority Data:	08/715,677 18 September 1996 (18.09.96) US	Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(71) Applicant:	LORD CORPORATION [US/US]; Crossroads Corporate Park, Building II, Suite 100, 110 Coming Road, Cary, NC 27511 (US).	
(72) Inventor:	HAIN, Harry, L.; 4529 Basswood Drive, Erie, PA 16506 (US).	
(74) Agents:	WAYLAND, Randall, S. et al.; Lord Corporation, Crossroads Corporate Park, Building II, Suite 100, 110 Coming Road, Cary, NC 27511 (US).	

(54) Title: VIBRATION ISOLATION INSERT FOR AIRCRAFT FLOOR PANELS AND THE LIKE



## (57) Abstract

An insert (20) used to connect aircraft floor panels (11), and the like, to supporting structure (13) includes features which function to isolate the supported panel (11) from vibrations in the supporting structure (13). The isolation of the panels (11) leads to reductions in SII. (Speech Interference Level) noise within aircraft cabins. The insert (20) consists of internal and external rigid components separated by a contoured elastomeric component (32). The elastomeric component (32) is preloaded when installed via a fastener (15) extending through the inner rigid component (42, 42') and attaching to the supporting structure (13). The outer (22, 22') and inner (42, 42') rigid components are sized such that the inner rigid component (42, 42') will not pass through the outer rigid component (22, 22'), thus providing a safetied installation of the panel (11). The elastomeric component (32) extends below the bottom of the outer rigid component (22, 22') and provides soft snubbing against the supporting structure during loading of the panels (11). This allows some level of isolation while restricting motion of the panels (11).

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SU	Singapore		
EE	Estonia						

## VIBRATION ISOLATION INSERT FOR AIRCRAFT FLOOR PANELS AND THE LIKE

### Background and Summary of the Invention

The present invention relates to an insert for an aircraft floor panel, or the like, used to attach the panel to a supporting structure. More particularly, the present insert has the capability to isolate the panel from the vibrational energy propagated through its support.

It has been determined that a large contribution to speech interference level (SIL) noise, in certain commercial aircraft, is radiated by the floor panels. Apparently, the vibration that is transmitted along the beams which support the panels effectively vibrate the panel similar to the way a speaker diaphragm is vibrated. In order to reduce weight, these panels are typically made of an aluminum honeycomb, or other highly rigid constructions, that are highly susceptible to vibration. One current method of attaching these panels to the support beams employs metal inserts that are staked to the floor panel and secured to the upper surface of the support beam using a screw inserted through the insert and threaded into a clip nut. This technique amounts to hard mounting the panel to the support providing a solid path for transmission of vibration.

The present invention significantly reduces SIL noise within the passenger compartment. The attachment insert of the present invention comprises a) a substantially cylindrical rigid outer member secured in an aperture in the floor panel and having an axial throughbore defining a minimum internal dimension of said outer member; b) a contoured elastomeric member bonded to said axial throughbore, said elastomeric member having a central axial opening therethrough and a portion surrounding the central axial opening that extends below a lowermost portion of said outer member; and c) a rigid inner member having a substantially cylindrical first portion of a first diameter which is press fit into said central axial opening of said elastomeric bushing and a shorter cylindrical second portion which has a second larger diameter than said first portion, said second portion generally overlying said contoured elastomeric member, rigid inner member having an axial fastener-receiving throughbore permitting attachment to said support. The outer diameter of the second portion is greater than the minimum internal dimension of the first member. As a result, the insert of the present invention is safetied against possible loss of elastomer integrity. The outer member has a flange which is used to bond the insert to the lower surface of the panel and provides pull-through resistance.

The contoured elastomer has a sleeve portion that extends along the outer periphery of the shank of the inner member and has a longer axial extent than said shank. In addition, the elastomeric member has a solid annulus that extends below the surface of the flange of the outer member. The excessive length of the sleeve results in the elastomer being preloaded in its secured position. The annulus provides a snubbing ring for the panel when the panel is loaded as by a passenger walking, a beverage/food cart, or by carry-on luggage placed beneath the seat. The annulus prevents the loading of the panel from creating a solid path; accordingly, the panel remains isolated from the vibrating support surface such that the SIL noise in the passenger compartment is still reduced.

10 Various other features, advantages and characteristics of the present invention will become apparent after a reading of the following specification.

#### Brief Description of the Drawings

Preferred embodiments of the present invention are described in accordance with  
15 the attached drawings in which

**Fig. 1** is a cross-sectional front view of a first embodiment of the insert of the present invention as seen along line 1-1 in Fig. 3;

**Fig. 2** is a top view of the first embodiment of the insert, approximately, actual size;

20 **Fig. 3** is a bottom view of the first embodiment of the insert;

**Fig. 4** is a cross-sectional front view of a second embodiment of the insert shown installed in a panel; and

**Fig. 5** is a partial isometric view of the floor assembly.

25

### Detailed Description of the Preferred Embodiments

A first preferred embodiment of the present invention is shown in Fig. 1 generally at 20. Rigid outer member 22 is shown as having a substantially cylindrical body portion 24 and a flange 26 which extends from a lower edge. Other shapes could, of course, be used; however, cylindrical will generally be preferred for ease of placement in the floor panels 11 (Fig. 4). Drilling a round hole will be simpler than punching out some other shape. The upper rim 28 of cylindrical body portion 24 has a reduced wall thickness that will be rolled over in a staking operation to secure it to panel 11. In addition, an adhesive will be applied to the upper surface 27 of flange 26 (Fig. 2) to secure it to the lower surface of panel 11.

Rigid outer member may be metallic, made of metals including aluminum, powdered titanium, or similar light weight metals, in which case the staking operation is mechanical. As an alternative, rigid outer member 22 may be made of an engineered plastic, such as ULTEM available from GE, for example. With such a plastic, an ultrasonic staking procedure can be used to form the upper flange to capture plate 11. Certain composites may also be appropriate for making the rigid members of this invention, such as glass or carbon fiber reinforced plastics. Rigid outer member 22 has a minimum internal dimension formed by inwardly projecting annulus 30.

A contoured elastomeric member 32 is bonded to an internal portion of rigid outer member 22. This bond may be either chemical in nature, i.e., produced using an adhesive, or mechanical, i.e., the elastomer may be molded in place. The elastomer is preferably one which will provide medium damping and has reasonable low temperature flexibility. A suitable elastomer is available from Lord Corporation and is identified as SPE®I. A portion of the elastomeric member 32 is contained within rigid outer member 22 and a portion extends beneath member 22. The elastomeric member 32 has a first predetermined axial length extending along the axis of the rigid outer member 22 and a central axial opening 33 that extends therethrough. The portion extending below member 22 is an annulus 34 made up of a plurality (preferably three) of load bearing portions 36 with a like plurality of intermediate bridging portions 38. An annular ring 40 underlies a portion of rigid outer member 22. The portion of the elastomeric member 32 contained within the rigid outer member has a configuration identical to that of annulus 34 with the exception of the absence of a ring corresponding to ring 40.

A third element of insert 20 is rigid inner member 42. Inner member 42 is preferably made of the same material as that used for rigid outer member, although a

different material could be used. Rigid inner member 42 has a first generally cylindrical portion 44 having a first outer diameter that is press fit into central axial opening 33. Inner member 42 has a second shorter generally cylindrical portion 46 which has a diameter which overlies the elastomeric member 32. The maximum diameter of second cylindrical portion 46 exceeds the minimum internal dimension of annulus 30. In this manner, insert 20 is safetied against the possible loss of integrity of the elastomeric member 32, i.e., the floor panel 11 cannot lift up off of the support 13 to which it is attached. Inner rigid member 42 has an axial fastener-receiving throughbore 48. The operation of insert 20 will be described in conjunction with the second embodiment.

Fig. 4 depicts a second embodiment generally at 20'. In this embodiment, the upper rim used to roll over on the panel 11 is omitted. The adhesive applied to upper surface 27' of flange 26' is sufficient to secure the panel in place making the staking operation unnecessary, resulting in significant savings in installation cost and time. All other features of this embodiment are identical to the first embodiment. As shown in Fig. 4, floor panel 11 is secured to the upper flange 13 of an I-beam support by a threaded fastener 15 and a clip nut 17. Nut 17 is slipped over flange 13, a hole 19 having been drilled in therein. Screw 15 is then inserted through fastener-receiving throughbore 48' and the insert 20' and panel 11 which is adhered thereto, are fastened to support flange 13. The predetermined axial length of the elastomeric member 32 exceeds the length of rigid inner member 42 (Fig. 1). Accordingly, as the fastener 15 is tightened, the elastomer of member 32 will be preloaded assuring continuous contact and consistent performance.

Elastomeric member 32' isolates outer member 22' from inner member 42' and, hence, floor panel 11 from support flange 13. Accordingly, certain vibrations being transmitted through flange 13 will not be transmitted into the floor panel 11 or the associated passenger compartment. The panel 11 will normally occupy an elevated position relative to flange 13 as depicted in Fig. 4. Should the panel be subjected to loading due to, for example, someone walking on it, beverage cart passing across it or carry-on luggage being stored on panel 11, the elastomer around load-carrying protrusions 36 will permit the panel to deflect downward until ring 40' engages flange 13. Ring 40' gently snubs this movement and even when under load, the panel 11 remains isolated from flange 13.

Flight tests of the present insert 20 demonstrated SIL noise reductions in the passenger compartment including approximately 5 decibels in the 500 Hz range and 10 dB

at each of the 2000 Hz and 4000 Hz levels. Approximately forty inserts 20 are used to secure a 2'X4' floor panel 11 in position. The inserts 20 used in the test employed outer and inner rigid members 22 and 42 that were made of aluminum. Fig. 5 illustrates a view of the floor structure including panel 11 and flange 13.

- 5        Various changes, alternatives and modifications will become apparent to a person of ordinary skill in the art after a reading of the foregoing specification. It is intended that all such changes, alternatives and modifications as come within the scope of the appended claims be considered part of the present invention.

**Claims**

What is claimed is:

1. An isolator mount (20), comprising:
  - 5 (a) an outer member (22) having a substantially cylindrical body portion and including an annulus (30) projecting inwardly from said substantially cylindrical body portion,
  - 10 (b) a contoured elastomer section (32) bonded to said outer member (22) and including a central axial opening (33), said contoured elastomer section (32) including a plurality of radially-spaced load bearing portions (36) positioned above said annulus (30), and
  - 15 (c) a rigid inner member (42) received in said central axial opening (33).
2. The isolator mount (20) of Claim 1 wherein said contoured elastomer section (32) includes an annular snubbing ring (40) including an axially exposed surface which underlies a portion of said rigid outer member (22) and prevents hard contact with said outer member (22).
  - 20
3. The isolator mount (20) of Claim 1 wherein said plurality of radially-spaced load bearing portions (36) are interconnected by a plurality of thinner bridging portions (38).
  - 25
4. The isolator mount (20) of Claim 1 wherein said contoured elastomer section (32) also includes plurality of radially-spaced load bearing portions (36) positioned below said annulus (30).
  - 30
5. The isolator mount (20) of Claim 4 wherein said plurality of radially-spaced load bearing portions (36) positioned below said annulus (30) extend along an exterior of a cylindrical portion of said inner member (42) beyond a farthest extent of said cylindrical portion whereby said plurality of radially-spaced load bearing portions (36) are precompressed upon installation.

6. The isolator mount of Claim 1 wherein said contoured elastomer section (32) includes a portion which overlies said annulus (30) on said outer member (22) which prevents contact between said outer member (22) and said inner member (42).

5 7. The isolator mount (20) of Claim 1 whercin another plurality of radially-spaced load bearing portions (36) are positioned below said annulus (30) and said contoured elastomer section (32) also includes an axially exposed annular ring (40) which underlies a portion of said outer member (22) and prevents hard contact with said outer element (22).

10 8. The isolator mount (20) of Claim 1 wherein said annulus (30) projects inwardly from said substantially cylindrical body portion at a lower portion thereof.

9. The isolator mount (20) of Claim 1 wherein said inner member (42) is pressed into said central axial opening (33).

1/3

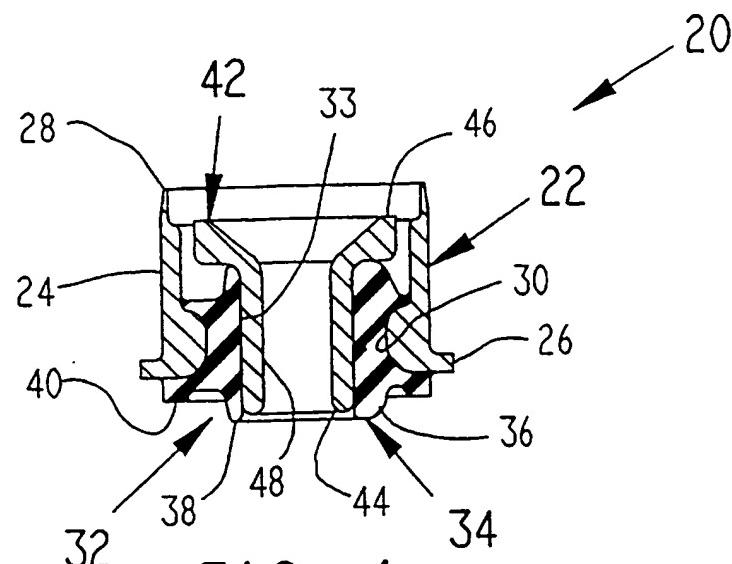


FIG. 1

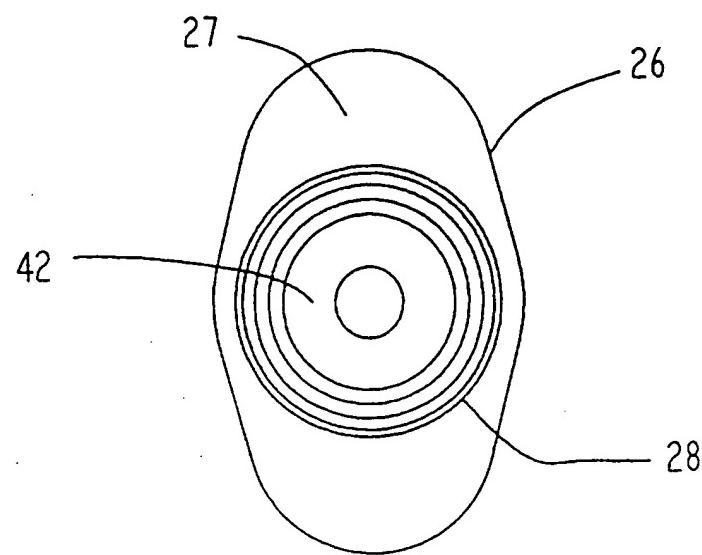


FIG. 2

2/3

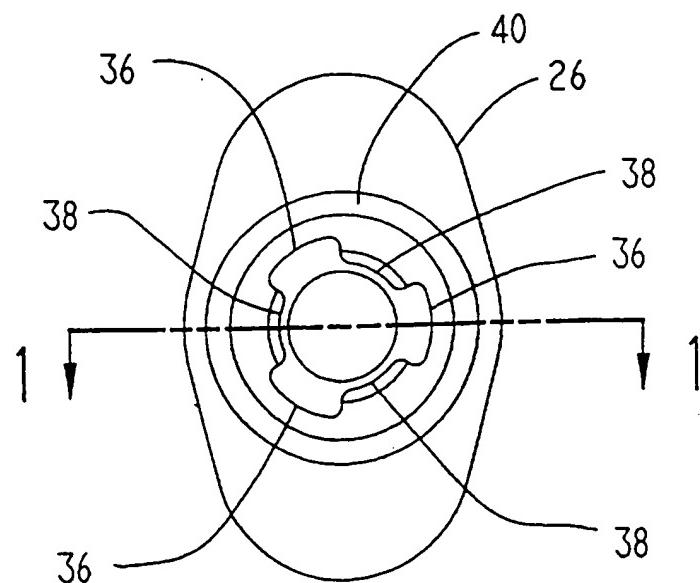


FIG. 3

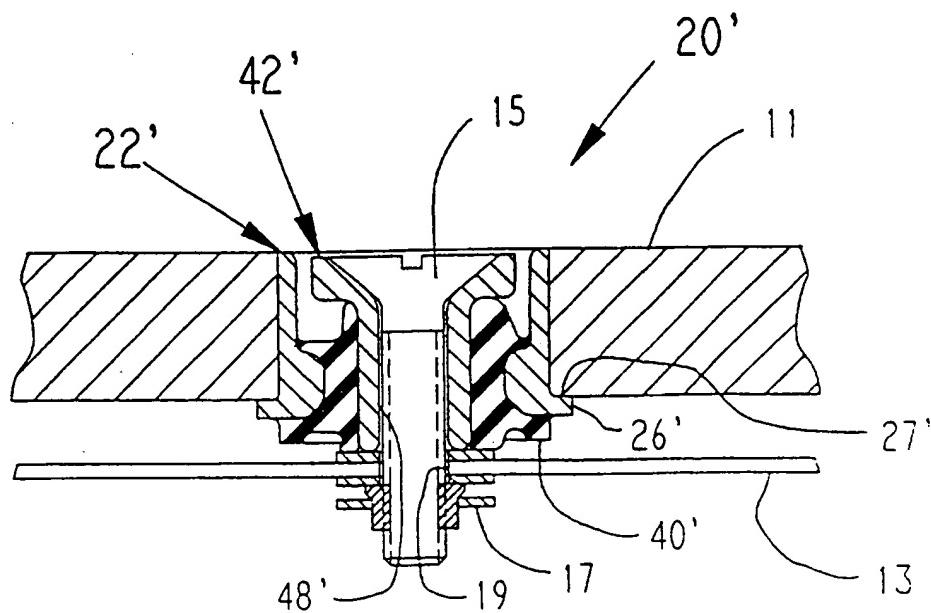


FIG. 4

3/3

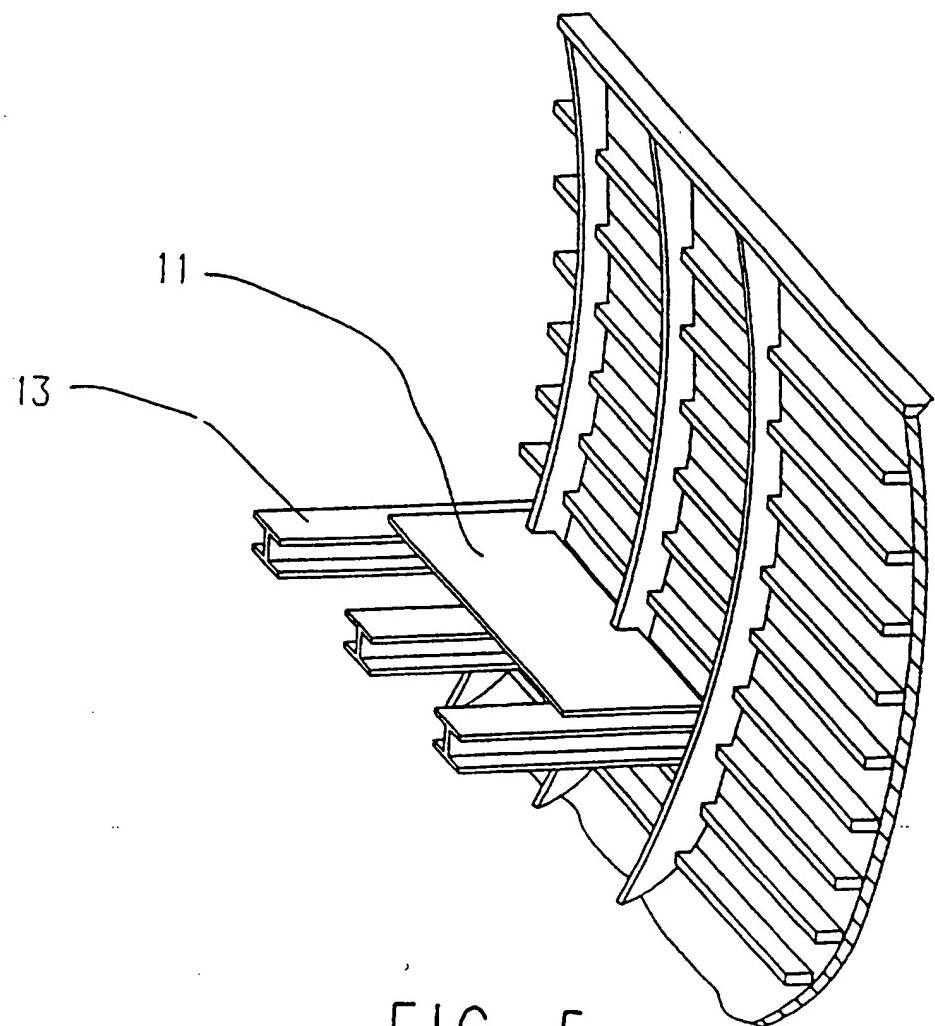


FIG. 5

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 97/15548

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 F16F1/38

According to International Patent Classification(IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 F16F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	FR 2 717 236 A (HUTCHINSON) 15 September 1995 see the whole document	1,3,6
Y	---	2,9
A	---	4,7,8
Y	DE 40 24 696 C (BOGE) 18 July 1991 see the whole document	2
Y	---	9
A	DE 829 388 C (P.C.HUTTON) 24 January 1952 see page 3, paragraph 2	5
Y	---	
A	US 4 521 004 A (CALDWELL WILLIAM F) 4 June 1985 see abstract; figures	
	---	
	-/-	

Further documents are listed in the continuation of box C

Patent family members are listed in annex

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

23 January 1998

30/01/1998

Name and mailing address of the ISA

European Patent Office, P B 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx 3' 651 npo nl.  
Fax (+31-70) 340-3016

Authorized officer

Pemberton, P

## INTERNATIONAL SEARCH REPORT

Int. Appl. No.  
PCT/US 97/15548

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
P,A	DE 196 05 859 A (METZELER GIMETALL AG) 21 August 1997 see the whole document ---	1
A	US 4 033 533 A (EVRARD GERARD MAURICE GASPARD) 5 July 1977 ---	
A	DE 84 24 307 U (METZELER) 12 September 1985 ---	
A	FR 1 089 844 A (EHRENREICH & CIE) 22 March 1955 ---	
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 189 (M-821) '3537! , 8 May 1989 & JP 01 015540 A (BRIDGESTONE), 19 January 1989, see abstract ----	
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 373 (M-861) '3721! , 18 August 1989 & JP 01 126447 A (KINUGAWA RUBBER) see abstract -----	

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 97/15548

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
FR 2717236 A	15-09-95	NONE		
DE 4024696 C	18-07-91	EP 0472823 A		04-03-92
DE 829388 C		DE 937564 C FR 63890 E FR 1027717 A GB 667232 A GB 714950 A US 2755056 A		13-10-55 20-05-53 17-07-56
US 4521004 A	04-06-85	NONE		
DE 19605859 A	21-08-97	WO 9730297 A		21-08-97
US 4033533 A	05-07-77	FR 2297360 A DE 2600434 A GB 1532054 A		06-08-76 15-07-76 15-11-78
DE 8424307 U	12-09-85	NONE		
FR 1089844 A	22-03-55	NONE		